Renewable Fuel Standard Program (RFS2)

February 2010

Overview

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- What are the Standards for 2010
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Highlights of the New RFS2 Program

- **Today's rule sets the full 2010 EISA renewable fuels volume standard.**
- **The RFS2 Regulations will go into effect July 1, 2010.**
- **EPA provides provisions for the transition from RFS1 to RFS2, including how to account for the full year volume requirements.**
- **The rule also establishes volume standards for specific categories of renewable fuels.**
- **2010 Standards:**
  - **Conventional Renewable Standard:** 12 billion gallons of corn ethanol or other qualifying renewable fuel.
  - **Biomass-Based Diesel Standard:** 1.15 billion gallons, - combines 2009 and 2010 standards, including special provisions to account for the 2009 biomass-based diesel volume requirements in EISA.
  - **Cellulosic Standard:** 6.5 million gallons.
- **In order to qualify for these new categories, fuels must demonstrate they meet certain minimum greenhouse gas reduction standards, based on lifecycle assessment, in comparison to the petroleum fuels they displace.**
- **Significant updates were made to the lifecycle assessment since the proposal. These updates were heavily informed by data collected during the public comment process and through an independent peer review of key components of the lifecycle modeling. Based on this updated analysis, EPA has determined that:**
  - **Ethanol produced from corn starch at a new natural gas, biomass, or biogas fired facility (or expanded capacity from such a facility) using advanced efficient technologies will meet the 20% GHG emission reduction threshold.**
  - **Biobutanol from corn starch meets the 20% threshold.**
  - **Biodiesel and renewable diesel from soy or waste oils, fats, and greases will meet the 50% GHG threshold for biomass-based diesel.**
  - **Biodiesel and renewable diesel produced from algal oils will comply with the 50% threshold.**
  - **Ethanol from sugarcane complies with the applicable 50% reduction threshold for advanced biofuels.**
  - **Cellulosic ethanol and cellulosic diesel (based on currently modeled pathways) comply with the 60% reduction**
- **The rule also provides a process to efficiently evaluate new fuels and feedstocks such as sorghum and other crops.**

Primary Changes Required by EISA

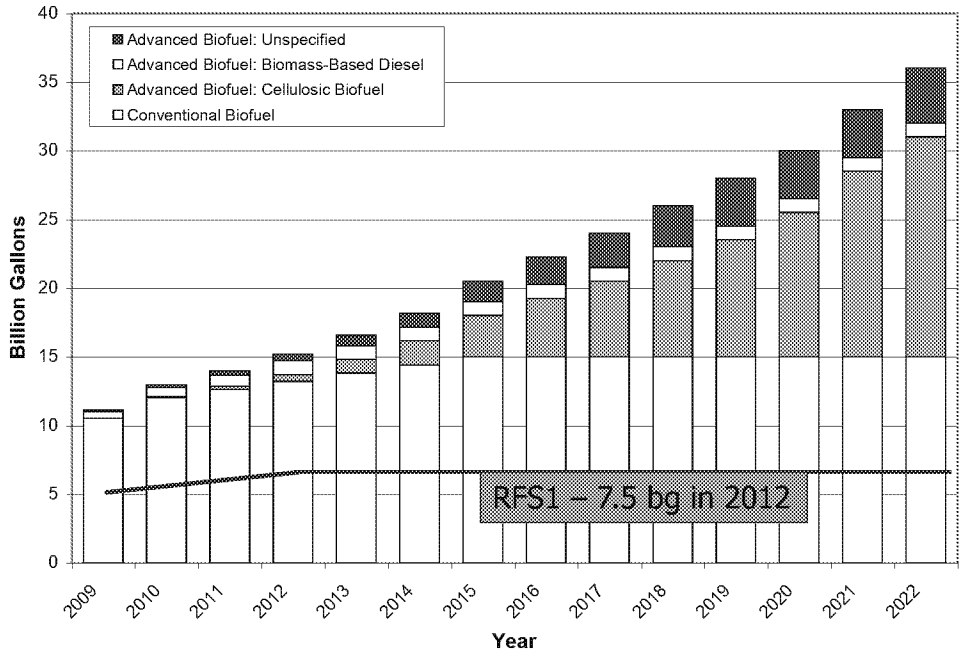
- **Energy Independence and Security Act (December 2007) required changes to the RFS program**
  - Significantly increased volumes of renewable fuel – to 36 billion gallons
  - Separation of the volume requirements into four separate categories of renewable fuel: cellulosic biofuel, biomass-based diesel, advanced biofuel, total renewable fuel
  - Changes to the definition of renewable fuels to include minimum lifecycle GHG reduction thresholds and grandfathering of volume from certain facilities
  - Restrictions on the types of feedstocks that can be used to make renewable fuel, and the types of land that can be used to grow and harvest feedstocks
  - Inclusion of specific types of waivers and EPA-generated credits for cellulosic biofuel

What are the New Standards?

- **Four Separate Standards**
  - **Biomass-Based Diesel: 1 Bgal by 2012 and beyond**
    - E.g., Biodiesel, "renewable diesel" if fats and oils not co-processed with petroleum
    - Must meet a 50% lifecycle GHG threshold
  - **Cellulosic Biofuel: 16 Bgal by 2022**
    - Renewable fuel produced from cellulose, hemicellulose, or lignin
    - E.g., cellulosic ethanol, BTL diesel, green gasoline, etc.
    - Must meet a 60% lifecycle GHG threshold
  - **Advanced Biofuel: Total of 21 Bgal by 2022 (Minimum of 4 billion additional)**
    - Essentially anything but corn starch ethanol
    - Includes cellulosic biofuels and biomass-based diesel
    - Must meet a 50% lifecycle GHG threshold
  - **Renewable Biofuel: Total of 36 Bgal by 2022 (Minimum of 15 Bgal additional)**
    - Ethanol derived from corn starch – or any other qualifying renewable fuel
    - Must meet 20% lifecycle GHG threshold - Only applies to fuel produced in new facilities

NOTE: Existing biofuel facilities (domestic and foreign) are not required to meet GHG threshold for conventional biofuel category – facilities are "Grandfathered."

RFS2 Volumes



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RFS2 Standards In 2010

- We are applying the EISA 2010 RFS2 standards for all of 2010 – 12.95 billion gallons
  - Most straightforward interpretation of the Act
- RFS2 regulatory program will go into effect on July 1, 2010
  - RFS1 regulations will apply January – June
- This means there will be both RFS1 and RFS2 Renewable Identification Numbers (RINs)* in the distribution system in 2010
  - Would have happened even if RFS2 started on Jan 1, since RFS1 RINs are in the marketplace and have a 2 year life
- Final Rulemaking provisions provide for this transition
  - RFS1 RINs are valid under RFS2, applied toward the separate standards based on codes within the RINs
  - RFS2 RINs will have distinct codes to differentiate them
- Final rule maintains ethanol equivalent energy-based approach for RFS2
  - Except biodiesel equivalent for the biomass-based diesel standard
  - Provides a level playing field across all renewable fuels
  - Maintains basis for investments based on RFS1, including all the work going on with renewable hydrocarbons and higher alcohols
  - Avoids any transition issues into RFS2

2010 Standards

- **Biodiesel**
  - Final rule combines the 0.5 bill gal biomass-based diesel requirement for 2009 with the 0.65 Bgal requirement for 2010.
  - All biodiesel RINs generated in 2009 count towards the standard
- **Cellulosic**
  - EISA includes annual cellulosic biofuel targets, starting with 100 million gallons in 2010
  - But each November, EPA sets the actual standard for the following year
  - Based on EIA's annual production assessment and other market assessments

Standards for 2010

(percentage of obligation)

Fuel Category	Percentage of Fuel Required to be Renewable	Volume of Renewable Fuel (in billion gal)
Cellulosic biofuel	0.004%	0.0065
Biomass-based diesel	*1.10%	*1.15
Total Advanced biofuel	0.61%	0.95
Renewable fuel	8.25%	12.95

**Combined 2009/2010 Biomass-Based Diesel Volumes Applied in 2010*

Facility Grandfathering

- **All post-enactment facilities (domestic and foreign) must meet minimum 20% GHG reduction**
- **All pre-enactment facilities (domestic and foreign) are grandfathered for the general renewable fuel category – estimated at ~15 Bgal**
  - Including ethanol facilities that start production in calendar years 2008 and 2009, and are fired with natural gas, biomass, or any combination
- **Basic approach:**
  - Grandfathered indefinitely
  - Only up to a baseline volume
- **Baseline volume based on:**
  - Maximum allowable volume stipulated in air permits
  - Lacking air permits, maximum capacity achieved is used
  - Also allowing a small tolerance of 5% to account for minor changes due to ongoing maintenance
- **Volume increases beyond the baseline must meet the 20% threshold like a new facility**

Updates to Lifecycle Modeling

- **Based on peer review results as well as other comments received we have made several updates to our modeling since the NPRM analysis**

- **Updates to Domestic Agricultural Sector Modeling:**
  - Incorporated forestry model results in our analysis
  - Added new land classifications; cropland, cropland-pasture, rangeland, forest-pasture, forest, CRP, developed land
  - Reflected new data on projected switchgrass yields
  - Updated N_2O / soil carbon numbers
    - Worked with Colorado State University DAYCENT/CENTURY models to update factors

- **Updates to International Agricultural Sector Modeling:**
  - Incorporated a Brazil module into the international model framework
    - Regional breakout of agriculture and pasture land
    - Includes pasture / cropland interactions
  - Added price induced yield changes
    - This is based on work done by CARD at Missouri and Iowa State and has different factors by crop and by country (e.g., long term elasticity for the Corn Belt in the U.S. 0.07)
  - Updated international agricultural GHG emission estimates based in part on new data from the International Fertilizer Industry Association (IFA)

- **Updates to Biofuel Processing in Both Domestic and International Agricultural Sector Modeling:**
  - Built in corn fractionation pathway (w/ co-product markets, etc.)
  - Adjusted DDG co-product replacement rates
    - Reflected results of new studies from Argonne and the University of Minnesota that indicate more efficient use of co-product
  - Added biodiesel glycerin co-product credit
  - Updated process energy use

- **Updates to Land Use Change Modeling:**
  - Included more geographic coverage of satellite data from 35 countries in the NPRM to 160 countries in the FRM
  - Used longer time coverage of satellite data - 2001-2007
  - Used higher resolution satellite data from the latest MODIS V5 release, 500m^2 resolution
    - Also augmented global satellite data with country / region specific data where available (e.g., data from Brazil on pasture intensification)

Key Updates which Drive Changes in Lifecycle Results Between Proposal and Final

For corn ethanol:

- Less overall indirect land use change (less land needed)
  - Based on new studies that show the rate of improvement in crop yields as a function of price, crop yields now increase in response to higher prices
    - This results in less land use needed domestically and globally for crops as biofuels expand
  - New research (from Argonne National Lab, University of Minnesota, and others) available since the proposal indicates corn ethanol co-products are now more efficient at providing animal feed (so need less corn for animal feed)
    - Therefore, we do not impact domestic corn exports as much
- The type of land converted has lower GHG impacts
  - Based on previous satellite data, the proposal assumed cropland expansion onto grassland would require an amount of pasture to expand into forest lands.
  - For the Final Rule improved economic modeling of the demand for pasture area and satellite data indicates that pasture could expand onto existing grasslands.

For soybean biodiesel:

- The new information described above also will lead to less overall indirect land use change (less land needed) from soybean biodiesel and the converted land has lower GHG impacts.
- In addition, latest IPCC guidance indicates reduced domestic soybean N_2O emissions.
- Updated USDA and industry data indicated reduction in energy use at the plants and a higher co-product credit.

For sugarcane ethanol:

- There is less overall indirect land use change (less land needed)
  - For the proposal, based on less aggregated satellite data, sugarcane expansion in Brazil resulted in cropland expansion into grassland and pasture replacing forest (similar to corn ethanol and soybean impacts)
  - Based on regional specific data from Brazil, historic trends, and disaggregated satellite data, in the final, sugarcane expands onto grassland and there is greater pasture intensification such that there is very little impact on forests
  - New data provided by commenters reduced sugarcane and ethanol process energy

Addressing Uncertainty - Sources of Uncertainty in our Analysis

- For the final rule analysis we are specifically addressing the uncertainty of the lifecycle results in three main ways:
  1. Getting the best information possible and updating our analysis to narrow the uncertainty
  2. Performing sensitivity analysis around key factors to test the impact on the results
  3. Establishing reasonable ranges of uncertainty and using probability distributions within these ranges in threshold assessment
- One of the key sensitivity analysis we performed was regarding crop yields
  - The economic modeling inputs (and specifically crop yield projections) was an area identified by reviewers and public comments – generally that we were underestimating potential yield growth
  - We analyzed a base yield and a high yield scenario to test the impact of this assumption on the overall results
- For the two key drivers of land use change we performed an uncertainty analysis and developed a range and distribution of results around the land use change emissions
  - Types of land converted (satellite data)
  - GHG emission factors associated with different types of land conversion
- For key methodology choices we have selected approaches based on feedback from the comment process and peer review
  - Where appropriate we will conduct sensitivity analysis around these decisions

Compliance Determination from LCA Results

- **Modeling accounts for the typical feedstock and fuel production pathway from which significant production and contribution to RFS2 volumes are expected (2022)**

- **Modeled fuel pathways meeting compliance:**
  - Ethanol produced from corn starch at a new natural gas, biomass, or biogas fired facility using advanced efficient technologies meets 20% threshold (Coal fired will not)
  - Butanol from corn starch meets 20% threshold
  - Biodiesel (soy, wastes, algae) meets 50% threshold
  - Sugarcane ethanol (multiple pathways) meets 50% threshold
  - Cellulosic ethanol and diesel fuel (Thermal and Biochemical from Stover, Switchgrass) meets 60% threshold

- **Results extended to same fuel type and feedstock as a modeled pathway but with feedstock production sources that were not included in the analysis (e.g., corn ethanol and soybean biodiesel produced in another country)**
  - If agricultural production from a source are significantly different from those modeled and fuel volumes from the source increase, EPA retains the authority to perform a full analysis of the different pathway for compliance determination

- **Results extended to other fuel pathways with low risk of not complying:**
  - Crop residues such as corn stover, wheat straw, rice straw, and citrus residue providing starch or cellulosic feedstock
  - Forest material including eligible forest thinnings and solid residue remaining from forest product production providing cellulosic feedstock
  - Secondary annual crops planted on existing crop land such as winter cover crops and providing cellulosic material, starch, or oil for biofuel production
  - Separated food and yard wastes, including food and beverage wastes from food production and processing
  - Perennial grasses including switchgrass and miscanthus

Approach Going Forward for Qualifying Additional Fuels Based on Lifecycle Modeling

- **Threshold determinations for certain other pathways were not possible at this time because sufficient modeling or data is not yet available. Based on current/projected commercial trends and status of analysis, EPA anticipates modeling the following fuel pathways and including determinations in a rulemaking within 6 months.**
  - wood pulp ethanol
  - grain sorghum ethanol
  - palm oil biodiesel
- **For other fuel pathways not yet modeled, EPA provides a petition process through which the fuel pathway can be analyzed and provided a compliance determination.**
  - Fuels pathways sufficiently similar to pathways that have been modeled (e.g., energy enhancement to fuel processing technology)
    - Upon determination, allow RIN-generation after next quarterly update of RIN reporting system (EMTS)
    - Formalize in regulations during annual rulemaking process
  - Fuel pathways that require significant new analysis and modeling (e.g., new feedstock or fuel type)
    - EPA would give notice and seek public comment
    - Carried out as part of annual rulemaking process
- **EPA recognizes that the state of scientific knowledge continues to evolve in this area, therefore, the Agency is committing to further reassess these determinations and lifecycle estimates**
  - EPA will request that the National Academy of Sciences over the next two years evaluate the approach taken in this rule, the underlying science of lifecycle assessment, and in particular indirect land use change, and make recommendations for subsequent rulemakings on this subject
  - This new assessment could result in new determinations of threshold compliance compared to those included in this rule that would apply to future production (from plants that are constructed after each subsequent rule)

Renewable Biomass Provisions – Approving Feedstocks

- **EISA restricted where feedstocks can grow and be harvested for use in producing renewable fuels for compliance with the RFS2 program**
  - Planted crops/crop residue from ag land cleared/cultivated prior to Dec. 2007
  - Planted trees/tree residue from nonfederal lands and tree plantations cleared/cultivated prior to Dec. 2007

- **Compliance Approach for feedstocks from the Non Agricultural land / Forest land**
  - **All renewable fuel producers using feedstocks from this sector can either**
    1: Individually verify and qualify their feedstocks following specific recordkeeping and reporting requirements OR

    2: Opt to form and participate in a consortium that employs a third party to conduct a verification program that acts to collectively verify and qualify these feedstocks for RFS2 renewable fuel production

- **Compliance Approach for feedstocks from planted crops / agricultural land**
  - For US produced feedstocks, producers can comply under an aggregate compliance approach
  - For Foreign produced ag feedstocks, rule provides future option for other (non-U.S.) sources of feedstocks to use aggregate compliance if source region can provide sufficient data to support aggregate analysis
  - Otherwise, producers must verify using one of the options applied in the non-ag / forest sector

Overview of Impacts of the RFS2 Program

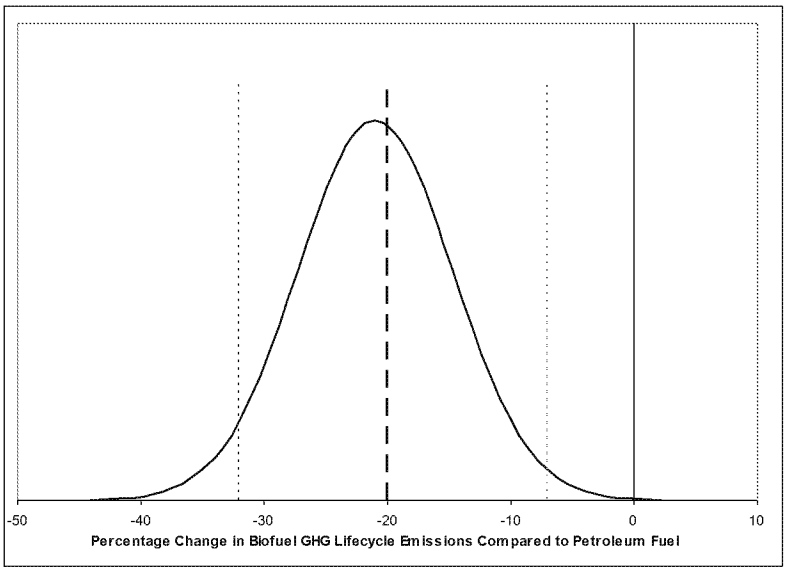
- **Petroleum Consumption, Energy Security and Fuel Costs:**
  - We estimate this program will replace about 7 percent of expected annual gasoline and diesel consumption in 2022
  - Decrease oil imports by $41.5 billion
  - Result in additional energy security benefits of $2.6 billion.
- **Greenhouse Gas Emissions:**
  - When fully implemented in 2022, renewable fuels are expected to reduce greenhouse gas emissions by 138 million metric tons -- equivalent to the annual emissions of 27 million passenger vehicles.
- **Agriculture Sector and Related Impacts:**
  - In 2022, the increased use of renewable fuels is expected to expand the market for agricultural products such as corn and soybeans and open new markets for advanced biofuels – increasing net farm income by an estimated $13 billion dollars.
- **Emissions and Air Quality:**
  - Increased use of renewable fuels will also impact emissions.
  - Some emissions such as NOx, acetaldehyde, and ethanol are expected to increase and others such as benzene and carbon monoxide are expected to decrease.
  - The impacts of these emissions on criteria air pollutants will vary from area to area.
  - EISA directs the agency to further evaluate these potential impacts and to mitigate, to the extent possible, any adverse impacts.

Questions?

- For Additional information:
  http://www.epa.gov/otaq/renewablefuels/index.htm
  - Includes Factsheets
  - RFS2 Rulemaking Package
    - Preamble
    - Regulations
    - Regulatory Impact Analysis
  - Links to Other Information

Appendix

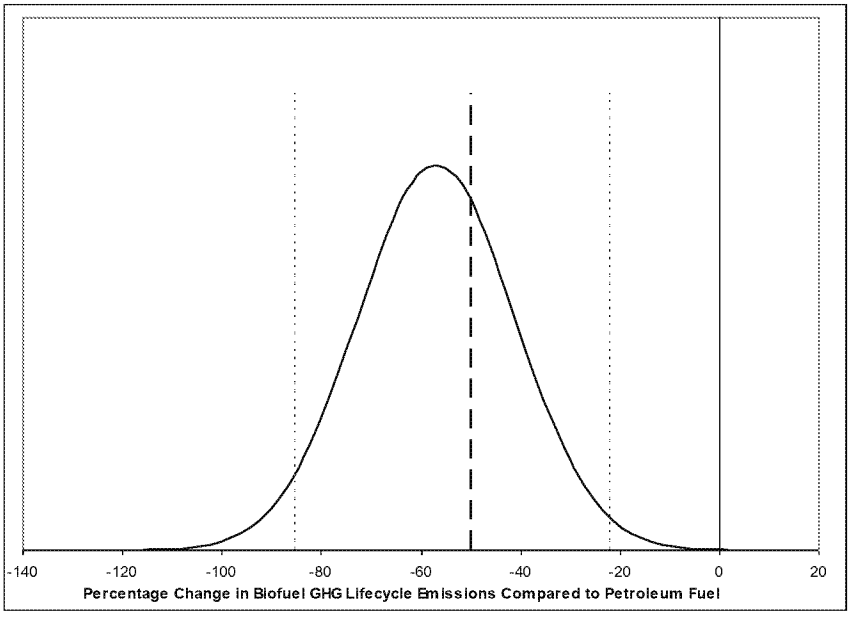
Corn Ethanol Results (2022 - 30 yr 0%)



Low	Mean	High
-32%	-21%	-7%

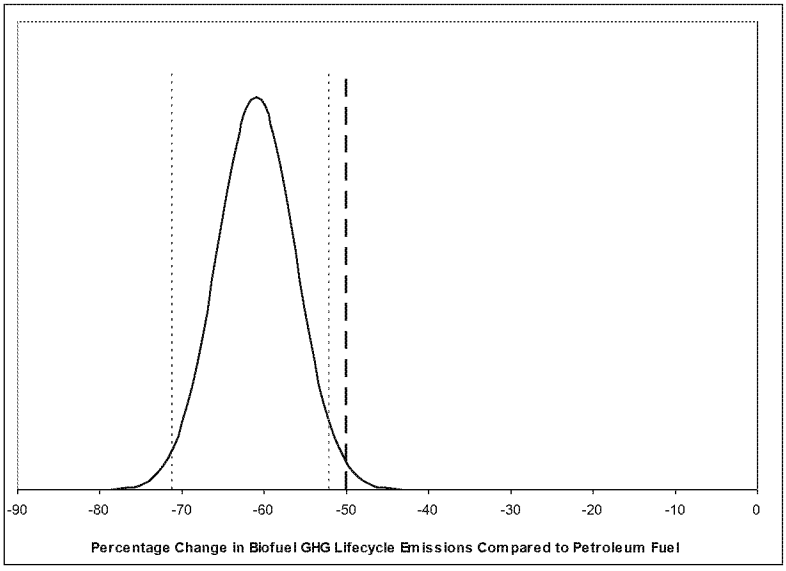
- Average 2022 plant: natural gas, 63% dry, 37% wet DGS (w/ fractionation)
- Lifecycle threshold only applies to new corn ethanol plants (others grandfathered)

Soybean Biodiesel Results (2022 - 30 yr 0%)



Low	Mean	High
-85%	-57%	-22%

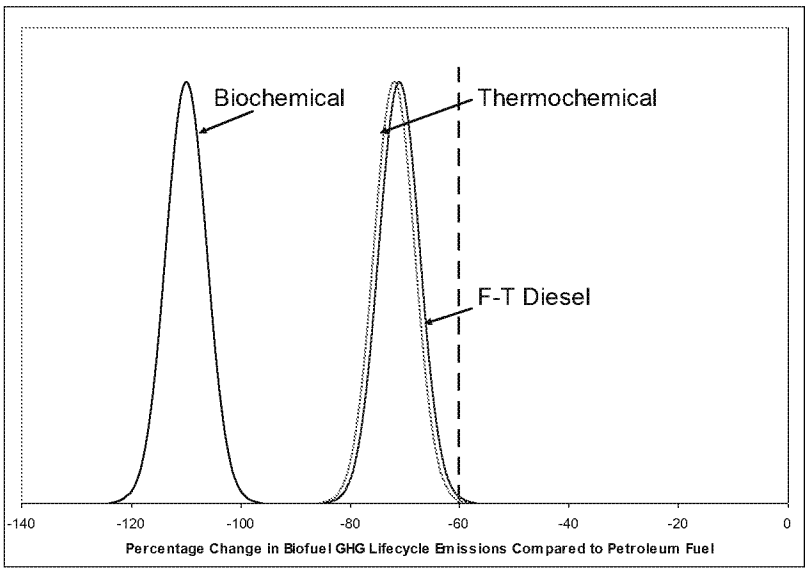
Sugarcane Ethanol Results (2022 - 30 yr 0%)



Low	Mean	High
-71%	-61%	-52%

- No CBI and limited residue collection / excess electricity production on-site

Switchgrass Ethanol Results (2022 - 30 yr 0%)



Range	Low	Mean	High
Biochemical	-117%	-110%	-102%
Thermochemical	-79%	-72%	-64%
F-T Diesel	-77%	-71%	-62%